

A new species of *Simulium* (*Simulium*) from Negros Island, the Philippines (Diptera: Simuliidae)

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Abstract: The female, male, pupa and mature larva of *Simulium* (*Simulium*) *malaibaense* sp. nov. are described on the basis of the specimens collected from Negros Occidental Province, Negros Island, the Philippines. This new species belongs to the *melanopus* species-group and is easily distinguished from all the known species by the female claw with a tiny rudimentary subbasal tooth, and the pupal gill with six filaments very widely diverged vertically.

Key words: *Simulium*, black fly, Simuliidae, Negros, Philippines, new species

The *melanopus* species-group of the subgenus *Simulium* (*Simulium*) Latreille s. str., originally defined by Takaoka (1983) and redefined by Takaoka (2003), is the most predominant element in the simuliid fauna of the Philippines, consisting of 25 of the 73 species of black flies so far recorded from the archipelago (Crosskey and Howard, 2004; Takaoka, 1983, 2006a, b, c, 2007; Takaoka and Tenedero, 2007). This paper describes one more new species of this species-group based on the specimens collected from Negros Island. This new species is distinctive within the *melanopus* species-group in that the female claw has a tiny rudimentary subbasal tooth.

The terms for morphological features used here follow those of Takaoka (2003). Holotype and paratype specimens of the new species are deposited at the Department of Infectious Disease Control, Faculty of Medicine, Oita University, Oita, Japan.

Simulium (*Simulium*) *malaibaense* sp. nov.

DESCRIPTION. **Female.** Body length 2.9

mm. **Head.** Narrower than width of thorax. Frons brownish-black, shiny, with several dark stout hairs along lateral margins and near lower margin; frontal ratio 1.31:1.00:1.10; frons-head ratio 1.00:3.35. Fronto-ocular area (Fig. 1A) shallow, triangular laterally. Clypeus brownish-black, shiny, whitish-gray pruinose, moderately covered with dark stout hairs except small areas near upper and lower margins bare; clypeus silvery iridescent when illuminated at certain angle of light. Labrum 0.6 times as long as clypeus. Antenna composed of scape, pedicel and 9 flagellomeres, medium to dark brown except scape, pedicel and base of 1st flagellomere yellow. Maxillary palp medium brown, composed of 5 segments, proportional lengths of 3rd, 4th, and 5th segments 1.00:1.14:2.24; 3rd segment (Fig. 1B) slightly enlarged; sensory vesicle (Fig. 1B) small, ellipsoidal, 0.24 times as long as 3rd segment, with large round opening medially. Maxillary lacinia with 14 or 15 inner and 15 outer teeth. Mandible with 26 inner and 16 outer teeth. Cibarium (Fig. 1C) with about 72 minute tubercles. **Thorax.** Scutum black, shiny, thinly whitish-gray pruinose, moderately covered with light to medium brown recumbent short hairs interspersed with dark brown long upright hairs on prescutellar area. Scutellum dark brown, shiny, with dark brown long

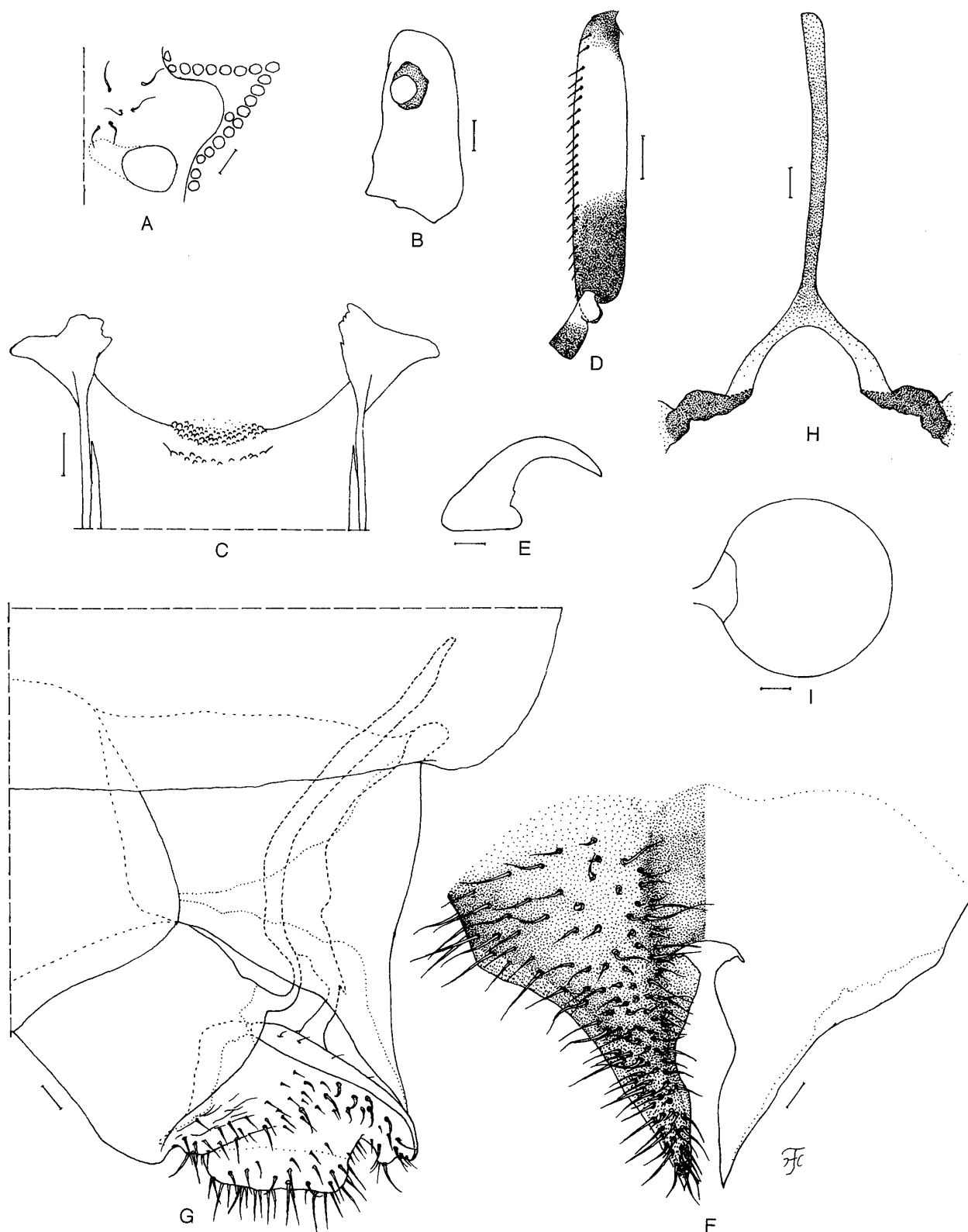


Fig. 1. Female of *Simulium* (*Simulium*) *malaibaense* sp. nov. A, fronto-ocular area (left side); B, 3rd segment of maxillary palp with sensory vesicle (left side; front view); C, cibarium; D, basitarsus and 2nd tarsal segment of hind leg showing calcipala and pedisulcus (left side, outer view); E, claw; F, 8th sternite and ovipositor valves *in situ* (ventral view); G, posterior tip of abdomen showing 8th sternite, genital fork, paraproct and cercus *in situ* (lateral view); H, genital fork (ventral view); I, spermatheca. Scale bars. 0.1 mm for D; 0.03 mm for A; 0.02 mm for B, C and F-I; 0.01 mm for E.

upright hairs. Postnotum dark brown, shiny, whitish-gray pruinose when viewed at certain angle of light and bare. Pleural membrane bare. Katepisternum longer than deep, dark brown, bare, shiny when illuminated. **Legs.** Dark brown to brownish-black except fore coxa, basal 1/2 of mid basitarsus, basal 3/5 of hind basitarsus (though base dark), and basal 1/2 of 2nd hind tarsal segment whitish-yellow. Fore tibia with whitish-gray (iridescent at certain angle of light) sheen widely on outer surface when illuminated, mid and hind tibiae with similar sheen on posterior surface; fore tarsus with thick dorsal crest of short hairs; fore basitarsus greatly dilated, 4.6 times as long as its greatest width; hind basitarsus (Fig. 1D) nearly parallel-sided, 5.25 times as long as its greatest width, 0.77 and 0.67 times as wide as greatest widths of hind tibia and femur, respectively; calcipala 1.3 times as long as width at base, and 0.33 times as wide as greatest width of basitarsus; pedisulcus distinct; claw (Fig. 1E) with tiny rudimentary subbasal tooth (it may be easily overlooked). **Wing.** Length 2.4 mm. Costa with spinules and hairs. Subcosta haired except near apex bare. Basal section of vein R bare; R₁ with spinules and hairs; R₂ with hairs only. Hairs at base of stem vein dark brown. Basal cell absent. **Abdomen.** Basal scale medium brown, with fringe of long hairs. Dorsal surface of abdominal segments medium brown to brownish-black, with dark hairs; 2nd segment with pair of large whitish iridescent dorsolateral spots broadly connected to each other medially; tergites 5–9 shiny. Ventral surface of abdominal segment 7 without sternal plate. **Genitalia.** Sternite 8 (Fig. 1F) well sclerotized, moderately depressed medially, moderately covered with long stout and medium-long fine hairs on each side, with posterior margin much produced posteriorly forming elongate lobes which are not well demarcated from ovipositor valves; these lobes (fused with ovipositor valve) tapered posteriorly with transparent bare pointed apex, nearly straight or slightly bent ventrally (Fig. 1G), and covered with numerous short to long hairs on ventral surface; inner margins of elongate lobes well sclerotized, moderately concave medially, moderately separated from each other. Genital fork (Fig. 1G, H) of inverted-Y form; stem slender and well sclerotized; arms slender, each with strongly-sclerotized angulate lateral ridge. Paraproct in lateral view

(Fig. 1G) much produced ventroposteriorly, about 1.8 times as wide as its basal length, covered with several medium-long stout hairs and numerous short fine hairs on lateral surface; paraproct anteroventrally with thin elongate moderately-sclerotized plate having round apical tip and 14 or 15 very short setae scattered on its surface. Cercus in lateral view (Fig. 1G) very short, with posterior margin nearly straight, about 3.6 times as wide as its greatest length, and covered with numerous hairs. Spermatheca (Fig. 1I) nearly globular, well sclerotized except duct and wide area of juncture to duct unsclerotized, without reticulate surface patterns; minute internal setae present; both accessory ducts subequal in diameter to each other, and also to that of main duct.

Male. Body length 3.2 mm. **Head.** Slightly wider than thorax. Upper eye consisting of large facets in 17 vertical columns and in 17 or 18 horizontal rows on each side. Clypeus brownish-black, whitish-gray pruinose, silvery iridescent when illuminated, moderately covered with dark brown long hairs though narrow median portion bare longitudinally. Antenna composed of scape, pedicel and 9 flagellomeres, dark brown except scape, pedicel, and base of 1st flagellomere yellow; 1st flagellomere somewhat elongate, 1.41 times as long as 2nd one. Maxillary palp composed of 5 segments, proportional lengths of 3rd, 4th, and 5th segments 1.00:1.14:2.24; 3rd segment (Fig. 2A) of normal size; sensory vesicle small, ellipsoidal, 0.20 times as long as 3rd segment, and with medium-sized opening. **Thorax.** Scutum black, with whitish-gray pruinose (silvery and bluish iridescent when illuminated) pattern composed of anterior pair of spots on shoulders, and large transverse band covering posterior 2/5 of scutum, which is connected to anterior pair of spots by broad band along lateral margins; anterior pair of spots moderately separated in middle (thus middle 1/3 of scutum non-pruinose); scutum densely covered with copper-colored fine short hairs interspersed with dark brown long upright hairs on prescutellar area. Scutellum dark brown, with dark brown long erect hairs. Postnotum dark brown, whitish-gray pruinose when viewed at certain angle of light. Pleural membrane and katepisternum similar to those of female. **Legs.** Dark brown to brownish-black except fore coxa yellow, basal 1/2 of mid basitarsus, basal 1/2 (or a little more) of hind basitarsus, basal

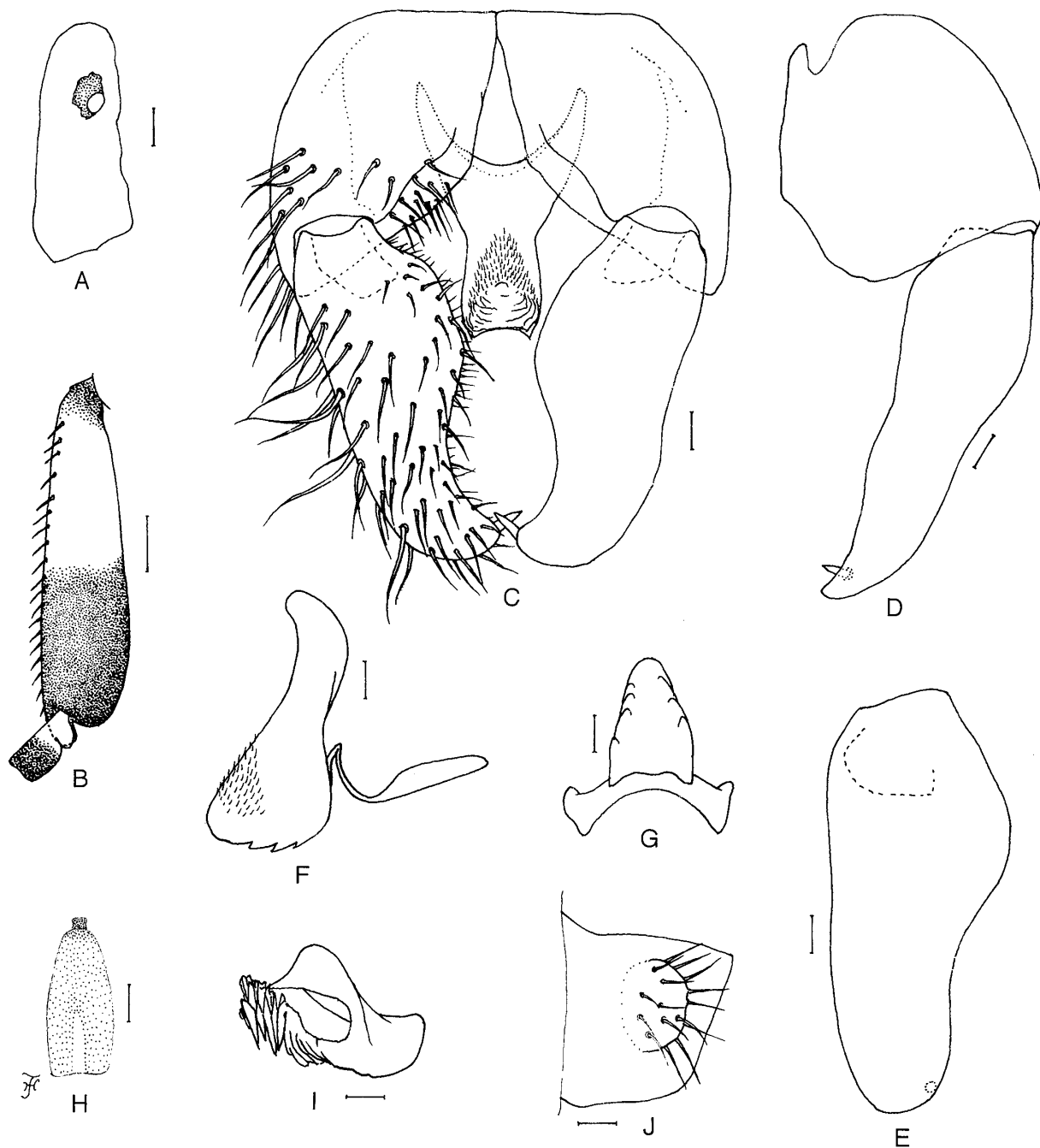


Fig. 2. Male of *Simulium* (*Simulium*) *malaibaense* sp. nov. A, 3rd segment of maxillary palp with sensory vesicle (right side; front view); B, basitarsus and 2nd tarsal segment of hind leg showing calcipala and pedisulcus (left side, outer view); C, coxites, styles and ventral plate *in situ* (ventral view); D, coxite and style *in situ* (right side, lateral view); E, style (right side; ventrolateral view); F, ventral plate and median sclerite (lateral view); G, ventral plate (end view); H, median sclerite (end view); I, paramere (left side; end view); J, 10th abdominal segment and cercus (right side; lateral view). Scale bars. 0.1 mm for B; 0.02 mm for A and C-J.

1/2 of hind 2nd tarsal segment whitish-yellow, and base of hind tibia dark yellow to light brown; fore tibia with grayish shiny sheen widely on outer surface, mid and hind tibiae with similar sheen almost entirely and basally on posterior surface, respectively, when illuminated at certain angle of light. Fore tarsus

with thick dorsal crest of short hairs; basitarsus greatly dilated, 4.9 times as long as its greatest width. Hind basitarsus (Fig. 2B) greatly enlarged, wedge-shaped, 3.74 times as long as its greatest width, 0.90 and 0.96 times as wide as greatest widths of hind tibia and femur, respectively; calcipala nearly as long as

its basal width, and 0.24 times as wide as greatest width of basitarsus; pedisulcus distinct. **Wing.** Length 2.4 mm; other characters as in female except subcosta entirely bare. **Abdomen.** Basal scale brownish-black, with fringe of long hairs. Dorsal surface of abdomen medium brown to brownish-black, with dark hairs; segments 2 and 5–7 each with pair of silvery iridescent dorsolateral spots, broadly connected in middle on segment 2 but not on other segments; tergites of segments 8 and 9 shiny laterally though not silvery iridescent at certain angle of light. **Genitalia.** Coxite in ventral view (Fig. 2C) subquadrate. Style in ventral view (Fig. 2C) elongate, longer than coxite, widened from base to middle, then narrowed toward apex, with inner margin of apical 1/2 moderately concave, and with stout spine near apex; style in lateral view (Fig. 2D) flattened ventrodorsally, without basal or sub-basal protuberance; style in ventrolateral view (Fig. 2E) 2.2 times as long as greatest breadth at basal 2/5. Ventral plate in ventral view (Fig. 2C) with body nearly rectangular having ventrally-produced median process which is bare except parts of lateral and anterior surfaces covered with minute setae, and is furnished with several teeth in vertical row on each posterolateral margin; basal arms short, stout and diverged; ventral plate in lateral view (Fig. 2F) with body and its ventrally-produced process with rounded ventral apex, with dentate posterior margin, and covered with minute setae anteromedially; ventral plate in end view (Fig. 2G) with body and ventrally-produced median process gradually widened dorsally, bare, with several teeth in vertical row on each lateral margin. Median sclerite in lateral view (Fig. 2F) moderately sclerotized, folded backwardly and then curved dorsally, and in posterior view (Fig. 2H) plate-like, slightly widened toward middle, then almost parallel-sided, and with deep unsclerotized cleft medially. Paramere (Fig. 2I) very wide basally and with several parameral hooks apically. Aedeagal membrane densely covered with minute setae, without sclerotized dorsal plate. Ventral surface of 10th abdominal segment without any distinct hairs. Cercus (Fig. 2J) rounded, with 16 or 17 distinct hairs.

Pupa. Body length (excluding gill filaments) about 3.5 mm. **Head.** Integument yellowish-brown, densely covered with round tubercles in neat order: frons with 2 simple (or

bifid) short trichomes separated widely from each other on each side; face with 1 simple short trichome on each side, which is subequal in length to those of frons. **Thorax.** Integument yellowish-brown, moderately covered with round tubercles or cone-shaped smaller tubercles except most of mediodorsal surface almost bare or very sparsely covered with round tubercles; thorax with 1 simple slender short trichome mediodorsally, 2 simple medium-long somewhat stout trichomes anterolaterally, 1 simple medium-long somewhat stout trichome posterolaterally, and 3 simple trichomes (1 short and slender, 2 medium-long and somewhat stout) ventrolaterally on each side; 1 short stout spinous trichome ventral to base of gill filaments. Gill (Fig. 3A) with 6 slender thread-like filaments in pairs; all pairs almost sessile or very short stalked; all filaments subequal in length (1.5–1.8 mm long) and thickness, yellowish-brown, gradually tapered toward apex; dorsalmost and ventralmost filaments very widely diverged basally at angle of 180 or more degrees; cuticular surface with very distinct annular ridges and furrows throughout their length, covered with minute tubercles of different sizes, relatively larger ones on ridges and smaller ones on interridge spaces. **Abdomen.** Dorsally, segment 1 light yellowish-brown and segments 2–9 almost transparent; segment 1 moderately covered with minute tubercles on posterior 1/2, with 1 simple slender short hair-like seta on each side; segment 2 bare, with 1 simple slender short hair-like seta, 2 simple short spinous setae and 3 simple stout spines on each side; segments 3 and 4 each with 4 simple hooked spines and 1 simple short seta on each side; segments 5–7 bare; segment 8 with well developed spine-combs in transverse row on each side; segment 9 without terminal hooks. Ventrally, all segments transparent; segment 4 with 2 simple hooklets and a few simple short setae on each side; segment 5 with pair of bifid hooks submedially and 1 simple short seta on each side; segments 6 and 7 each with pair of bifid inner and outer hooks widely spaced and 1 simple short seta on each side. Grapnel-like hooklets absent. **Cocoon** (Fig. 3B, C). Shoe-shaped, moderately and thinly woven, whitish, not extending ventrolaterally; individual threads invisible; 4.0–4.2 mm long by 1.6–1.8 mm wide; front collar 0.7–1.0 mm high.

Mature larva. Body length 6.0–6.4 mm.

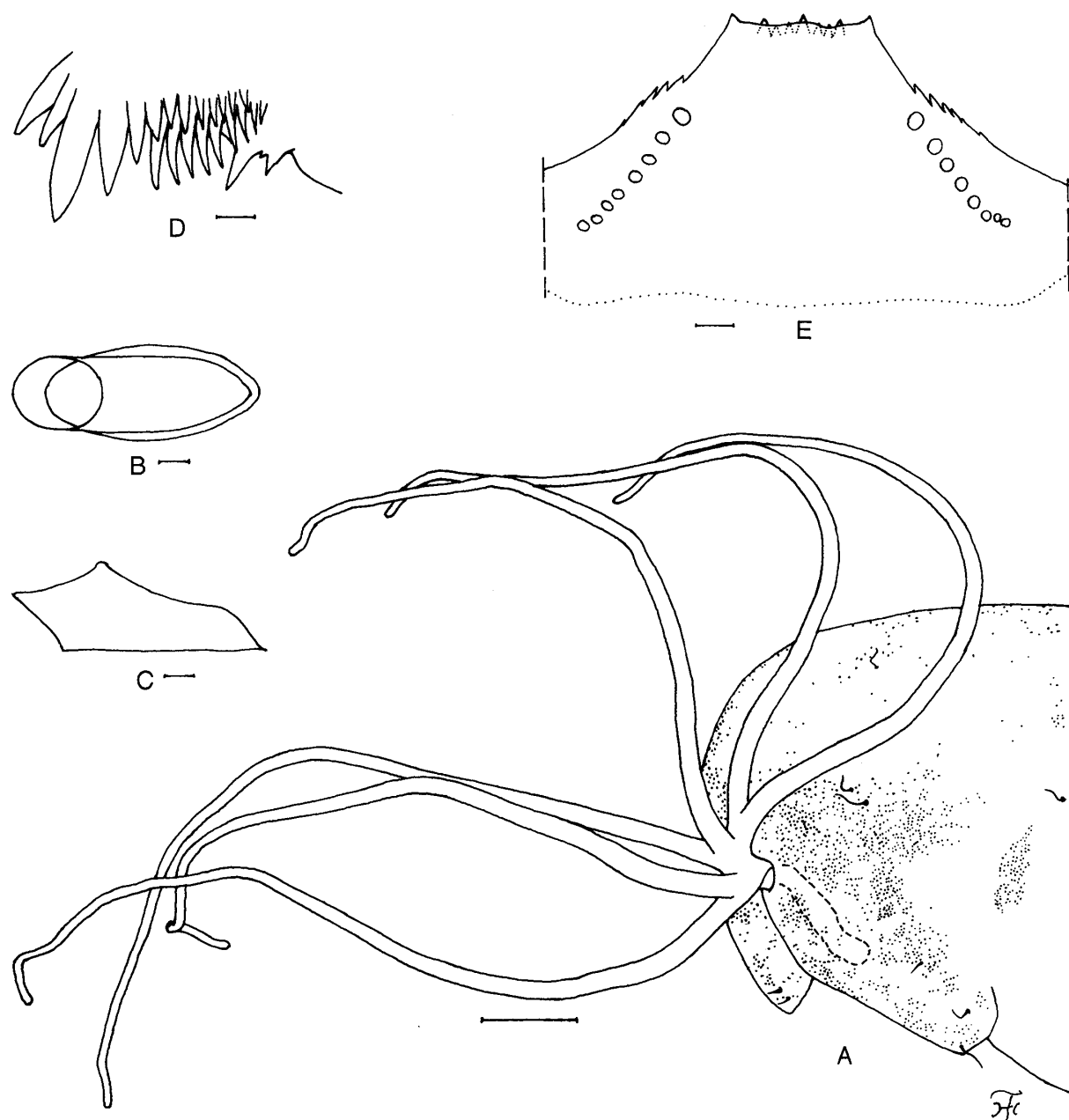


Fig. 3. Pupa and mature larva of *Simulium* (*Simulium*) *malaibaense* sp. nov. A–C, pupa; D and E, larva. A, anterior 2/3 of thoracic integument showing gill filaments, trichomes, and tubercles (left side; outer view); B and C, cocoons (B, dorsal view; C, lateral view); D, mandible; E, hypostoma. Scale bars. 0.5 mm for B and C; 0.2 mm for A; 0.02 mm for E; 0.01 mm for D.

Body color light to dark gray, though brownish on posterior segments in some larvae. Abdomen slightly becoming wider from segment 1 to segment 6, widest between segments 6 and 7, then narrowed from segment 7 to segment 9 when viewed dorsally. Cephalic apotome variable in color pattern with background whitish-yellow to dark brown unevenly, and with head spots appearing negative or merged into background color (Fig. 4A–D). Lateral surface of head capsule entirely dark brown except eye-

spot region narrowly whitish-yellow and/or narrow area along anterior margin whitish-yellow to yellow (Fig. 4E, F), or almost yellowish except posterior 1/2 or less light to medium brown (Fig. 4G). Ventral surface of head capsule medium to dark brown except hypostoma and transverse band along posterior margin of hypostoma yellow (Fig. 4H) or almost yellowish except narrow areas near posterior margin light to medium brown (Fig. 4I). Cervical sclerite composed of 2 yellow small elliptical



Fig. 4. Larval head capsules of *Simulium (Simulium) malaibaense* sp. nov. A–D, dorsal view; E–G, lateral view; H and I, ventral view.

pieces, not fused to occiput which extends medially, very widely separated medially from each other. Antenna composed of 3 segments and apical sensillum, slightly longer than stem of labral fan; proportional lengths of 1st, 2nd, and 3rd segments 1.00 : 1.38 : 0.75. Labral fan with 42–44 main rays. Mandible (Fig. 3D) with mandibular serrations composed of 2 teeth; major and longer tooth at obtuse angle to mandible on apical side; 1 or 2 supernumerary ser-

rations often present on each side of shorter mandibular tooth; comb-teeth decreasing in length from 1st to 3rd. Hypostoma (Fig. 3E) with 9 anterior teeth, median tooth most prominent, outer tooth of 3 intermediate teeth subequal in length to corner teeth, and middle tooth of 3 intermediate teeth smallest; lateral margins moderately serrate subapically; 8 hypostomal bristles widely diverging posteriorly from lateral border on each side.

Postgenal cleft (Fig. 4H, I) large, rounded apically, leaving narrow postgenal bridge. Thoracic cuticle almost bare. Abdominal cuticle almost bare except each side of anal sclerite moderately covered with short colorless setae. Rectal scales absent. Rectal organ of compound lobes, each with 11–14 finger-like secondary lobules. Anal sclerite X-shaped, with broadened anterior arms about 0.52 times as long as posterior ones, with wide thinly-sclerotized extension between anterior arms; basal juncture area with open closed space medially or deep incision opening posteriorly; no sensilla on basal juncture area and 7–12 sensilla posterior to posterior arms. Last abdominal segment somewhat bulged laterally, lacking ventral papillae. Posterior circlet with 124–134 rows of hooklets with up to 17–20 hooklets per row.

TYPE SPECIMENS. Holotype female (with its associated pupal exuviae and cocoon), reared from a pupa collected from a stream at Barangay Malaiba, Negros Occidental, Negros Island, Philippines, 6. II. 2007, by H. Takaoka and V. F. Tenedero. Paratypes: 4 females, 3 males (all reared from pupae), 9 mature larvae, same data and date as those of the holotype.

ECOLOGICAL NOTES. The pupae and larvae of this new species were collected from trailing grasses in a moderately-flowing stream (width 6–9 m, water temperature 21.0°C, exposed to sun, altitude about 660 m). No other species was collected from the same stream. Microsporidan infections were found in 3 (4.1%) of the 74 immature larvae collected.

ETYMOLOGY. The species name *malaibaense* refers to the Barangay Malaiba where this new species was collected.

REMARKS. *Simulium* (S.) *malaibaense* sp. nov. is easily assigned to the *melanopus* species-group by the elongate paraproct and the elongate lobes of the eighth sternite fused to the ovipositor valves of the female genitalia (Fig. 1F, G), the pupal gill with six filaments (Fig. 3A) and the

shoe-shaped cocoon (Fig. 3B, C).

This new species is remarkable in that the female claw bears a very minute rudimentary tooth (Fig. 1E). The female claw with a small or medium-long distinct subbasal tooth is commonly seen in most of the known species of the *melanopus* species-group though the female claw is simple in four species, i.e., *S.* (S.) *discrepans* Delfinado, *S.* (S.) *neodiscrepans* Takaoka, *S.* (S.) *tumpaense* Takaoka and Roberts and *S.* (S.) *landonoense* Takaoka (Takaoka, 1983, 2003, 2006a; Takaoka and Roberts, 1988). The female adult of this new species is also characterized by the sensory vesicle with a large opening (Fig. 1B) and the relatively wide frons.

The male adult of this new species is similar to *S.* (S.) *taalense* Takaoka in many features including the large body size, the color pattern of the scutum, the color of the legs, and the number of the vertical columns of large upper eye facets on each side (Takaoka, 1983) but differs by the copper-colored short hairs on the scutum and the much enlarged hind basitarsus (Fig. 2B).

The pupa of *S.* (S.) *malaibaense* sp. nov. is characterized by a combination of the head integument densely covered with tubercles and the thoracic integument very sparsely covered with tubercles dorsally (Fig. 3A), as well as the widely diverged gill filaments (Fig. 3A).

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